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Gymnophthalmus underwoodi Grant, 1958 (Reptilia: Gymnophthalmidae), a new record for the island of Montserrat

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Abstract. Two species of gymnophthalmids are known to inhabit islands in the West Indies, the unisexual *Gymnophthalmus underwoodi* Grant, 1958 and the bisexual *G. pleii* Bocourt, 1881, but neither has been previously recorded on Montserrat. Small microteiid lizards were observed between 2008 and 2016 at 5 locations on Montserrat. Scale counts and mitochondrial 16S rDNA sequences of specimens confirmed them to be *G. underwoodi*. The widespread distribution of this ninth lizard species on Montserrat suggests that it has gone undetected for some time or has rapidly colonized the island.

Key words. Caribbean; Lesser Antilles; Microteiid; Smooth-scaled Worm Lizard; Underwood's Spectacled Tegu; West Indies.

Montserrat is a small volcanic island on the northern end of the Lesser Antilles (Fig. 1). The volcanic eruptions (1995–2012) and subsequent pyroclastic flows and lahars have made the southern portion of the island uninhabitable.

The reptilian fauna of Montserrat consists of 8 lizards (4 endemic, 2 introduced), 2 snakes (both endemic), an introduced tortoise, and 4 marine turtles (Malhotra & Thorpe 1999, Hedges & Conn 2012). Here we report the presence of a ninth lizard on Montserrat, *Gymnophthalmus underwoodi* Grant, 1958, for the first time in the scientific literature.

Gymnophthalmus underwoodi (Underwood's Spectacled Tegu) is a unisexual species that originated through hybridogenesis (Cole et al. 1990, 1993). This species was originally described from Barbados (Grant 1958) and it has been additionally recorded in northeastern South America and many islands in the West Indies (Table 1). It is considered to be introduced to some Lesser Antillean Islands (Williamson & Powell 2004, Henderson & Powell 2009).

A second species, *Gymnophthalmus pleii* Bocourt, 1881, is also found on Antillean islands with described endemic subspecies occurring on Martinique and St. Lucia (Thomas 1965). Near Montserrat, both species of *Gymnophthalmus* have been recorded on Guadeloupe (Breuil 2002), Martinique where the species may be sympatric (Breuil 2009), and Dominica where the species are allopatric (Daniells et al. 2008, Turk et al. 2010).

Small microteiid lizards were observed from 2008–2016 at five locations on Montserrat (Fig. 1) on both the Caribbean (west) and Atlantic (east) sides of the island (Anonymous 2014, G. Gray and S. Mendes, Montserrat Department of the Environment, pers. comm.). Four observations were near the coast and one (RES and N. Shoobs in 2016) was at approximately 230 m elevation (Montserrat Tourist Board 1983). Under a Memorandum of Understanding between the Depart-

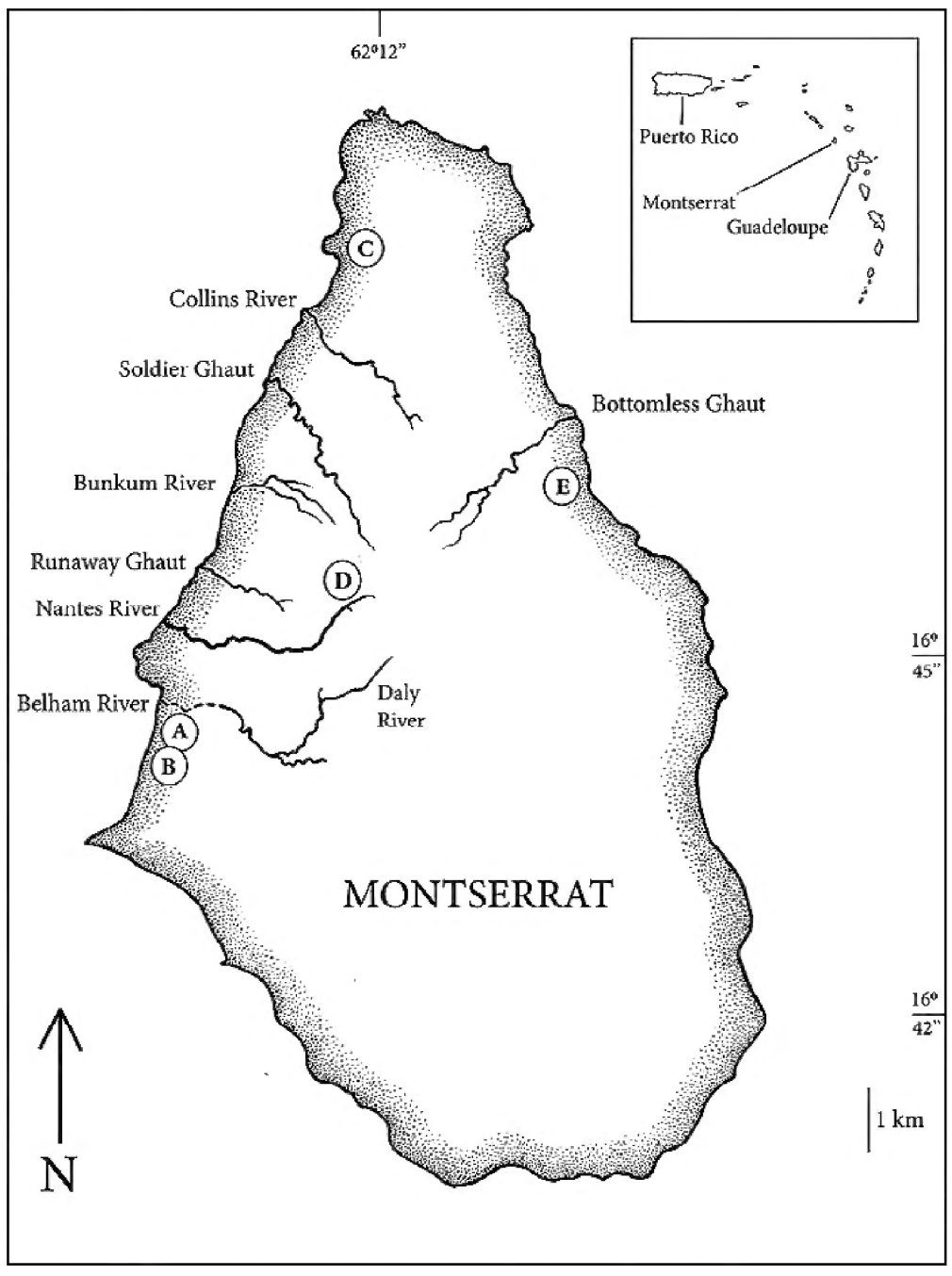

Figure 1. Map of Montserrat showing localities where *Gymnophthalmus* lizards were collected or observed. (A) Isles Bay 2008, from photograph archived at the Department of the Environment, Montserrat. (B) Fox's Bay Trail (Anonymous 2014), photograph and sighting. (C) Rendezvous Bay Trail (Anonymous 2014), sighting. (D) Headwaters of Nantes River 2016, sighting (RES and N. Shoobs). (E) Beach south of Bottomless Ghaut 2016 (this study), sighting and specimens collected. Inset shows the position of Montserrat relative to Puerto Rico and islands in the Lesser Antilles.

Table 1. Countries where *Gymnophthalmus underwoodi* has been documented. Records from COLE et al. 1990 represent museum specimens. Specific islands are noted where information is available.

Country	Source (Island)
Cuba	ALFONSO et al. 2012
Dominican Republic	SCANTLEBURY et al. 2010 (Hispaniola)
Saint-Martin/ Sint Maarten	VAN BUEL & POWELL 2006
Saint-Barthélemy	QUESTEL & BOGGIO 2012
Antigua and Barbuda	CENSKY & LINDSAY 1997 (Barbuda) POWELL & LINDSAY 1999 (Antigua) DALTRY 2007 (Great Bird Island)
Saint Kitts and Nevis	ORCHARD 2010 (Saint Kitts)
Montserrat	This study
Guadeloupe	COLE et al. 1990 (Basse-Terre) COLE et al. 1990 (Grande-Terre) BREUIL 2002 (La Desirade) BREUIL 2002 (Marie-Galante) BREUIL & SERRE-COLLET 2012 (Terre-de-Haut)
Dominica	COLE et al. 1990
Martinique	BREUIL 2002
Barbados	GRANT 1958
Saint Vincent and the Grenadines	COLE et al. 1990 (Saint Vincent) LAZELL & SINCLAIR 1990 (Bequia) DAUDIN & DE SILVA 2007 (Mustique) DAUDIN & DE SILVA 2007 (Union)
Grenada	COLE et al. 1990 (Grenada) WILLIAMSON et al. 2002 (Hog Island)
Trinidad and Tobago	COLE et al. 1990 (Trinidad) HENDERSON & POWELL 2009 (Las Cotorras) HENDERSON & POWELL 2009 (Gaspar Grande Island)
Venezuela	GORZULA & SEÑARIS 1998
Guyana	COLE et al. 1990
Suriname	COLE et al. 1990
French Guiana	COLE et al. 1990
Brazil	COLE et al. 1990

ment of the Environment, Montserrat and Bard College at Simon's Rock (with a special permit drafted to allow transport of specimens to the United States), 2 lizards were collected by hand on 6 January 2016 and 14 January 2016 on the east side of the island south of Bottomless Ghaut among beachside vegetation (16°46′08.7″ N, 062°10′02.2″ W, geodetic datum WGS84; Fig. 2). The specimens collected are presumed to be hatchlings as the snout–vent length of the 2 lizards was 18 mm and 19 mm, respectively (HARDY et al. 1989; Fig. 3).

Figure 2. Beach habitat south of Bottomless Ghaut where *Gymnophthalmus underwoodi* specimens were collected.

The lizards were maintained alive for 2 weeks, euthanized by freezing, and fixed in 95% ethanol. In the laboratory, scale counts used to distinguish *G. underwoodi* from *G. pleii* (THOMAS 1965, COLE et al. 1990, HOOGMOED et al. 1992) were done on both specimens under a dissecting microscope. The specimens are now deposited in the New York State Museum herpetology collection (#6431 and #6432).

Genomic DNA was extracted from a small piece of tail from specimen #6432 preserved in 95% ethanol using a DNeasy Blood and Tissue Kit (Qiagen, Inc.). Purified DNA was then PCR amplified at 1 mitochondrial (16S) and 1 nuclear (*c-mos*) locus. A 500 base pair fragment of 16S rDNA was generated using the primers 16Sar and 16Sbr (PALUMBI et al. 1991, GenBank accession number KX66265) and a 390 base pair fragment of the nuclear gene *c-mos* was generated using the primers G73d and G74d (SAINT et al. 1998, GenBank accession number KX66266). Forward and reverse sequences were aligned and edited in BioEdit (HALL 1999) and MEGA 6 (TAMURA et al.

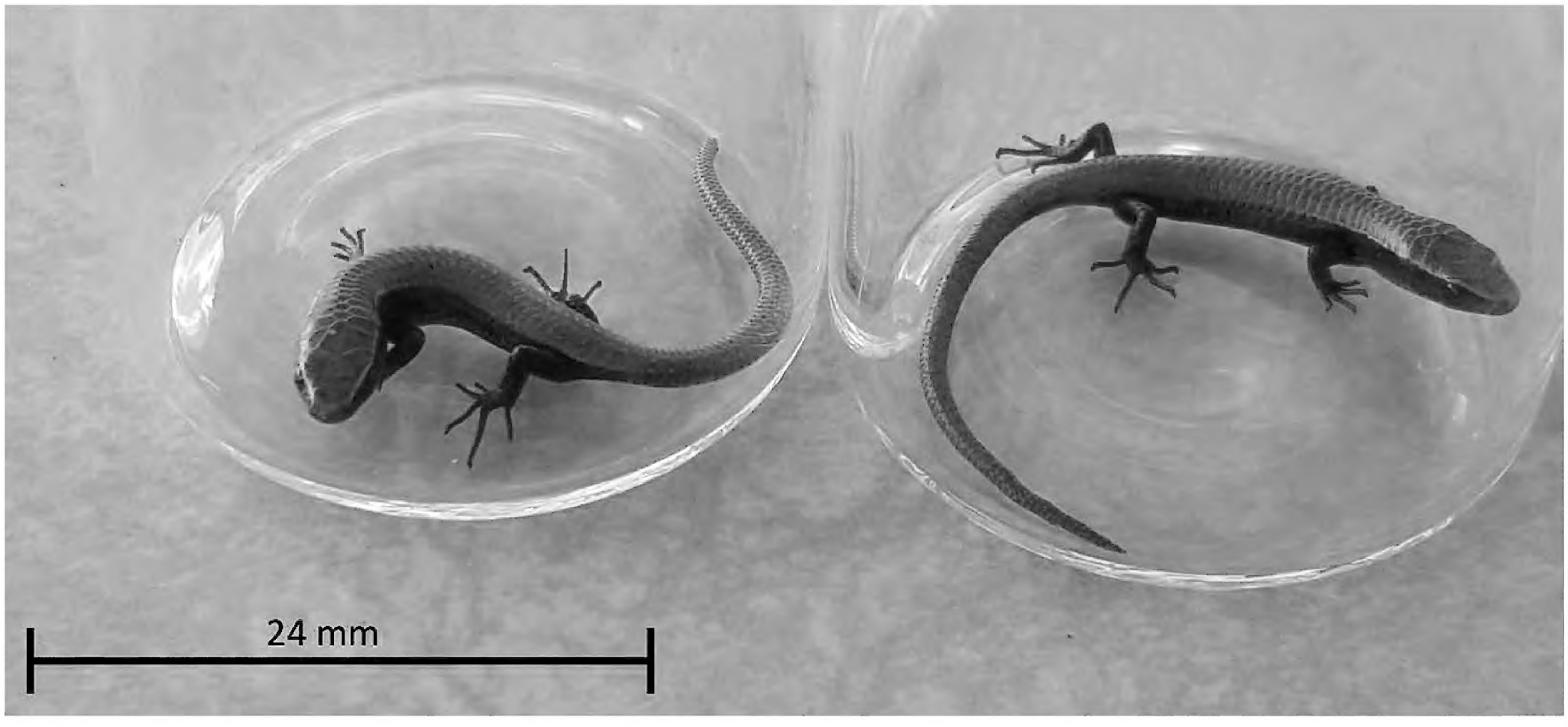

Figure 3. Hatchling *Gymnophthalmus underwoodi* specimens collected for analysis.

Table 2. Scale counts of the two Montserrat specimens and known Antillean species of *Gymnophthalmus* published in COLE et al. (1990), HOOGMOED et al. (1992), and THOMAS (1965).

Character	Montserrat	*Gymnophthalmus underwoodi*	*Gymnophthalmus pleii*
Subcaudal scales	Smooth	Smooth	Keeled
Infralabials (total) *	8	8–9	6
Supralabials (total) *	12	10–12	8–10
Ventral scales †	21–23	21–24	24–29
Mid-body scales	13	13	16–19
Left toe lamellae ‡	16	16–18	17–21

* Counted to the posterior edge of eye on both sides.
† Counted from enlarged pectoral scale to (but not including) enlarged preanal scale.
‡ Counted on fourth toe from claw to (but not including) foot.

2013). Both sequences were compared to sequences published in the NCBI database (http://www.ncbi.nlm.nih.gov/genbank/) using a BLAST search, and DNA sequences similar to those of the Montserrat gymnophthalmid were downloaded and aligned using ClustalW (MEGA 6). Alignments were edited, poorly aligning flanking regions were removed, and p-distances (transitions + transversions) were computed between the newly generated sequences and the most similar published sequences (MEGA 6).

Morphological characters, including the presence of smooth ventral scales, and the number of labial, ventral, mid-body and, toe scales (Table 2), were consistent with *Gymnophthalmus underwoodi*. This identification was also supported by the DNA analysis.

A BLAST search of the 16S sequence from the Montserrat gymnophthalmid retrieved roughly 1830 base pair mitochondrial sequences (KIZIRIAN & COLE 1999) from *G. underwoodi, G. cryptus, G. speciosus, G. pleii,* and *G. leucomystax*, and roughly 540 base pair sequences from *G. leucomystax* and *G. vanzoi* (PELLEGRINO et al. 2001). The alignment of these sequences with that of the Montserrat gymnophthalmid generated a 461 base pair region in which all sequences overlapped. In this region, there were no replacements between the 16S sequence from the Montserrat gymnophthalmid and that published for *G. underwoodi* (Genbank Accession #AF101369.1); however, the 2 sequences differ in that the Montserrat sequence has apparent deletions (GT, TG or GC) at 8 regularly spaced 60 base pair intervals. A larger alignment of 16S sequences from the Gymnophthalmidae reveals that all the *Gymnophthalmus* sequences published by KIZIRIAN & COLE (1999) have an insertion of G, GT, GC or GS roughly every 60 base pairs when compared to 16S sequences from the two *Gymnophthalmus* sequences published by PELLEGRINO et al. (2001) and indeed to all other members of the Gymnophthalmidae. Therefore the apparent insertion/deletion differences between the Montserrat gymnophthalmid sequence and the published sequence for *G. underwoodi* likely do not reflect a true difference between these 2 sequences but may in fact be the result of a data processing flaw present in the published *G. underwoodi* sequence.

The BLAST search of the *c-mos* sequence from the Montserrat gymnophthalmid returned the only other available *Gymnophthalmus c-mos* sequences, *G. vanzoi* and *G. leucomystax*. In the 390 base pair (130 amino acid) alignment of these three sequences, the Montserrat *c-mos* sequence had a p-distance of 0.023 from *G. vanzoi*, and 0.036 from *G. leucomystax*. The translated amino acid sequences were identical in *G. vanzoi* and *G. leucomystax*, while the Montserrat sequence had a single amino acid replacement (p-distance of 0.008).

Morphological and genetic analysis reveal that the *Gymnophthalmus* species sampled from Montserrat is in fact *G. underwoodi*, extending the rapidly expanding range of *G. underwoodi* to a new Lesser Antillean island nation. The presence of smooth subcaudal scales and several scale counts clearly distinguish this lizard from *G. pleii*, the only other species in the genus that is found in the Lesser Antilles. The *G. underwoodi* sampled from Montserrat has an identical 16S sequence to *G. underwoodi* sampled by KIZIRIAN & COLE (1999) from Barbados, Guyana, Suriname, and Trinidad. This paper also represents the first *c-mos* sequence published for *G. underwoodi*, adding a nuclear marker for future comparisons within this group.

Whether the colonization of *G. underwoodi* on Montserrat represents a natural or artificial introduction is uncertain, as the origin of this lizard remains ambiguous on many islands in the archipelago (DANIELLS et al. 2008, BREUIL 2009, POWELL et al. 2011). Unisexual species, such as *G. underwoodi*, may have an easier time dispersing and establishing new populations than bisexual species since a population of the former could descend from a single individual. Once *G. underwoodi* becomes established, populations can grow quickly (DALTRY 2007, TURK et al. 2010). TURK et al. (2010) found that *G. underwoodi* exhibited a broader distribution across xeric habitats than the bisexual *G. pleii* on Dominica. BREUIL (2009) observed a decrease in *G. pleii* populations with respect to *G. underwoodi* in some locations on Martinique where the species are found sympatrically, suggesting that the more recent arrival of *G. underwoodi* may result in the displacement of the endemic *G. pleii* in some areas.

Identification among cryptic *Gymnophthalmus* species is difficult (COLE et al. 1990). Therefore, it is still conceivable that some of the other observations of microteiids on Montserrat were *G. pleii* since only 2 specimens from 1 location were analyzed. The presence of this similar species on neighboring islands makes its presence on Montserrat appear possible. Thus, a thorough search for microteiids on Montserrat should be done. Habitats for the Montserrat specimens, caught or observed, are among dry leaves in open forest and in beach vegetation, which is consistent with habitat used by *G. underwoodi* on other islands (DAUDIN & DE SILVA 2007, DANIELLS et al. 2008, HENDERSON & POWELL 2009, TURK et al. 2010). The

wide distribution of this species on Montserrat suggests that this lizard has been present, undetected, for a relatively long time, certainly before the volcanic eruptions beginning in 1995. However, Daltry (2007) documented the rapid establishment of this species on Great Bird Island in Antigua, so it is conceivable that *G. underwoodi* exhibited a similar population explosion on Montserrat. It is likely that *G. underwoodi* has also gone undetected or has been misidentified on other Antillean islands and the range of this small but adept colonizer may be extended to include new locales in the near future.

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